

# Activity 9-4

## Derivatives of Hydrocarbons I

### Introduction

Most organic compounds are named from, and can be considered related to, corresponding hydrocarbons. Homologous series of such hydrocarbon derivatives occur when one or more hydrogen atoms of the hydrocarbon have been replaced by other atoms or groups. The alcohols, in which one or more hydrogen atoms have been replaced by  $\text{—OH}$  groups, make up one such group of hydrocarbon derivatives.

1. In alcohols, one or more of the hydrogen atoms of a hydrocarbon have been replaced by  $\text{—OH}$  groups.
2. The number of  $\text{—OH}$  groups that can be attached to one carbon atom under ordinary conditions is one.
3. Why are alcohols not considered Arrhenius bases under ordinary conditions? The  $\text{—OH}$  groups in alcohols are covalently bonded. They do not form  $\text{OH}^-$  ions in water solution.

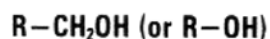
### Classifying alcohols

4. Alcohols may be classified according to the number of  $\text{—OH}$  groups in the molecule. What does each of these terms mean as applied to alcohols?
  - a. Monohydroxy (monohydric) one  $\text{—OH}$  group per molecule
  - b. Dihydroxy (dihydric) two  $\text{—OH}$  groups per molecule
  - c. Trihydroxy (trihydric) three  $\text{—OH}$  groups per molecule
5. Alcohols may also be classified according to the number of carbon chains attached to the carbon having the  $\text{—OH}$  group. What is a primary carbon atom? a carbon bonded to only one other carbon atom

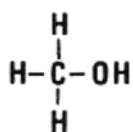
How does a primary carbon atom compare to secondary and tertiary carbon atoms?  
secondary carbon atoms are bonded to two other carbon atoms, tertiary to three other carbon atoms

6. What is a primary alcohol? an alcohol in which the  $\text{—OH}$  group is bonded to a primary carbon atom
7. Where is the  $\text{—OH}$  group found on the chain of carbon atoms in a molecule of any primary alcohol? at the end of a chain or branch

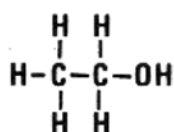
8. What is the general formula for a primary alcohol?



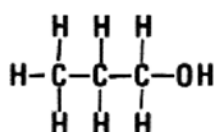
9. a. In the space below, give the IUPAC names, molecular formulas, and structural formulas for the first three primary alcohols.



methanol

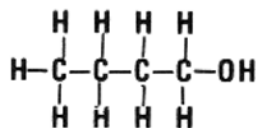


ethanol

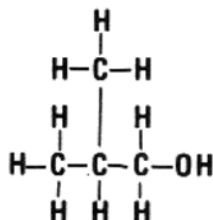


1-propanol

b. Give the IUPAC names and structural formulas for the two isomers of  $C_4H_9OH$  that are primary alcohols.

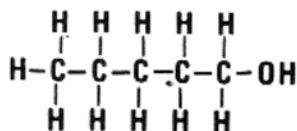


1-butanol

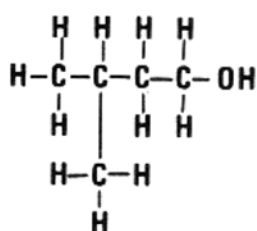


2-methyl-1-propanol

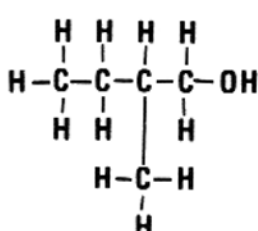
c. Give the IUPAC names and structural formulas for the four isomers of  $C_5H_{11}OH$  that are primary alcohols.



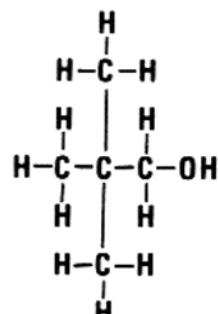
1-pentanol



3-methyl-1-butanol



2-methyl-1-butanol



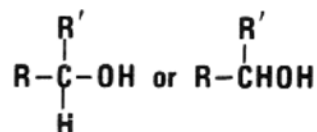
2,2-dimethyl-1-propanol

## Secondary and tertiary alcohols

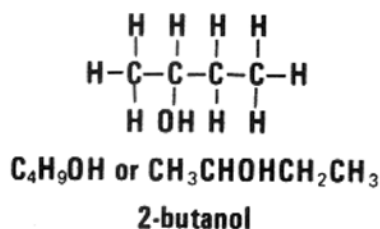
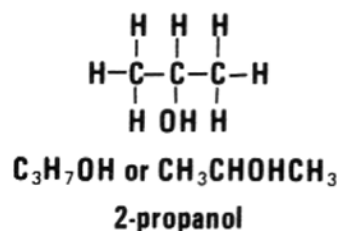
10. What is a secondary alcohol? an alcohol in which the -OH group is bonded to a secondary carbon atom

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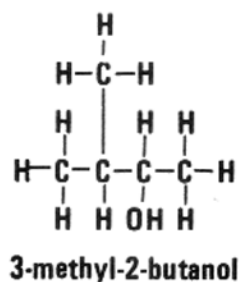
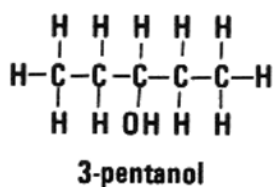
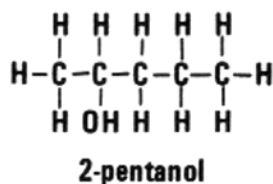
11. What is the general formula for a secondary alcohol?



12. Give the IUPAC names, molecular formulas, and structural formulas for the secondary alcohols that have 3 and 4 carbon atoms.



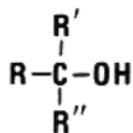
13. Give the IUPAC names and structural formulas for the three isomers of  $\text{C}_5\text{H}_{11}\text{OH}$  that are secondary alcohols.



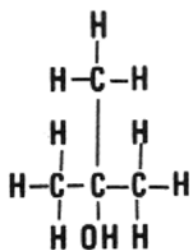
14. What is a tertiary alcohol? an alcohol in which the -OH group is bonded to a tertiary carbon atom

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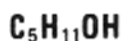
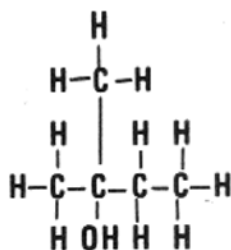
15. What is the general formula for a tertiary alcohol?



16. Give the IUPAC names, molecular formulas, and structural formulas for the tertiary alcohols that have 4 and 5 carbon atoms.



2-methyl-2-propanol

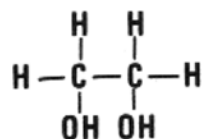


2-methyl-2-butanol

## Dihydroxy and trihydroxy alcohols

17. What is a dihydroxy alcohol? an alcohol that has two -OH groups in its molecule

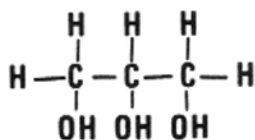
18. Give the common name and structural formula for 1, 2-ethanediol.



ethylene glycol  
(antifreeze)

19. What is a trihydroxy alcohol? an alcohol that has three -OH groups in its molecule

20. Give the IUPAC name and structural formula for glycerol.



1,2,3-trihydroxypropane  
or  
1,2,3-propanetriol

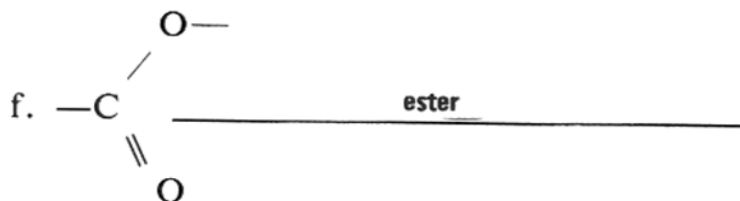
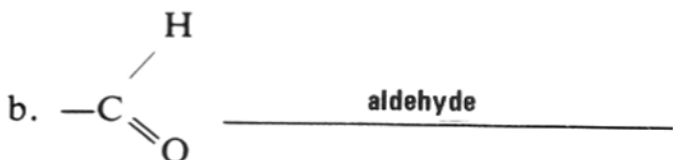
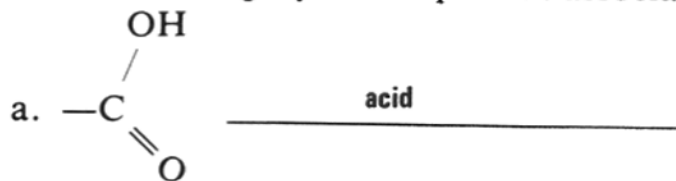
# Activity 9-5

## Derivatives of Hydrocarbons II

### Functional groups

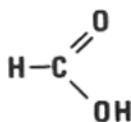
1. What is a functional group? the atom or group of atoms that characterizes the structure of a family of organic compounds and determines many of their properties

2. Name the category of compounds associated with each of the following functional groups.

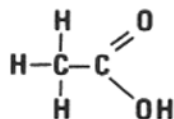


### Acids

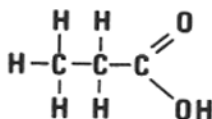
3. What is the general formula for an organic acid?  $\text{R}-\text{C}(=\text{O})\text{OH}$  Give the structural formula, common name, and IUPAC name for each of the following acids.



formic acid  
methanoic acid



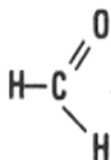
acetic acid  
ethanoic acid



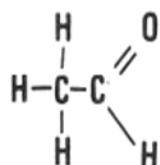
propionic acid  
propanoic acid

# Aldehydes, ketones, and ethers

4. What is the general formula for an aldehyde?  $\text{R}-\overset{\overset{\text{O}}{\parallel}}{\text{C}}-\text{H}$  Give the structural formula and IUPAC name for each of the following aldehydes.

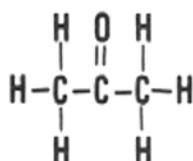


methanal



ethanal

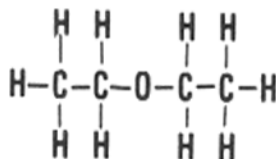
5. What is the general formula for a ketone?  $\text{R}-\overset{\overset{\text{O}}{\parallel}}{\text{C}}-\text{R}'$  Give the structural formula, common name, and IUPAC name for the simplest ketone, CH<sub>3</sub>COCH<sub>3</sub>.



acetone

propanone

6. What is the general formula for an ether?  $\text{R}-\text{O}-\text{R}'$  Give the structural formula and name for the ether C<sub>2</sub>H<sub>5</sub>OC<sub>2</sub>H<sub>5</sub>.



diethyl ether